REMARKS/ARGUMENTS

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

Claims 1-20 remain pending.

Claim 1 has been amended above to recite more specifically that the first axial bearing is a first axial friction bearing. This is well understood and supported by the original specification wherein it is provided that the first axial bearing is a hydrostatic bearing in which shear forces cause rotational drag in the bearing thereby limited the rotational speed of the cutting disc when free running. As well understood from this claim, according to the invention wherein a radial bearing and a first axial friction bearing are provided there is no direct axial mechanical linkage between the drive shaft and the disc.

Previously presented claims 1-3, 5-7 and 17-20 were rejected under 35 USC 102(b) as anticipated by WO 00/46486. Further, claims 14-16 were rejected under 35 USC 103(a) as unpatentable over WO '486. Applicant respectfully traverses these rejections.

Anticipation under Section 102 of the Patent Act requires that a prior art reference disclose every claim element of the claimed invention. See, e.g., Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1574 (Fed. Cir. 1986). While other references may be used to interpret an allegedly anticipating reference, anticipation must be found in a single reference. See, e.g., Studiengesellschaft Kohle, G.m.b.H. v. Dart Indus., Inc., 726 F.2d 724, 726-27 (Fed. Cir. 1984). The absence of any element of the claim from the cited reference negates anticipation. See, e.g., Structural Rubber Prods. Co. v. Park Rubber Co., 749 F.2d 707, 715 (Fed. Cir. 1984). Anticipation is not shown even if the differences between the claims and the prior art reference are insubstantial and the missing elements could be supplied by the

knowledge of one skilled in the art. See, e.g., Structural Rubber Prods., 749 F.2d at 716-17.

WO '486 addresses *inter alia* the issue addressed by the present invention. However, WO '486 uses a geared arrangement and not a friction controlling bearing to control the speed of the disc. Therefore, as detailed more specifically below, it is respectfully urged that the Examiner's rejection of the claims over WO '486 cannot properly be maintained.

Oscillating disc cutter (ODC) technology is relatively new and in many ways still under development. The cutter works by driving a disc cutter to oscillate about its central axis. The oscillation of the disc provides a percussive effect when brought into contact with rock. The percussive impact forces are offset by a large inertial reaction mass distributed around the cutter.

Importantly, as it applies to the current invention, the disc is powered to oscillate but is free to rotate (or not rotate) about its axis. That is, the disc cutter, identified with reference numeral 602 in applicant's drawings is attached to the offset drive on the drive shaft 612 by means of a radial bearing 609. There is no direct axial mechanical linkage between the drive shaft and the disc. As a result, if held loosely, even with the drive shaft powered, the disc cutter is free to rotate or to remain stationary as the drive shaft rotates. In this respect, it is believed that the Examiner may not have fully appreciated the disclosed and claimed structure. For example, in paragraphs 5 and 6 of the Examiner's Office Action, the Examiner has said "it would have been obvious since rmp (sic; RPM) can be controlled by the drive means". This statement is not consistent with the object of the invention which is to prevent over-speeding of the disc when it is free running and not engaged with the rock face.

This over-speeding problem that the present invention addresses, and that the particular embodiment in WO '486 attempts to solve, arises because no mechanical

bearings are completely friction-less. Despite the attempt at angular isolation between the drive shaft 612 and cutting disc 602 by means of bearing 609, the small amount of drag in bearing 609 will, when drive shaft 612 is at normal operating speed, result in torque being passed to the cutting disc. This torque acts to rotate the disc, eventually increasing its speed to match or closely match that of the drive shaft. At least this is the case when the disc is not in engagement with anything such as the rock face. The "spinning up" of the cutter head might nor ordinarily be an issue except that, as described in applicant's specification, when applying the head to the rock face, the head is suddenly slowed. In fact, in normal operation, due to the oscillating motion, the head will actually rotate in a direction opposite to the drive shaft.

This issue is fully described in both WO '486 at page 10, line 32 – page 11, line 15 and in the background of the invention section of the present application at page 1, lines 15-28 which recites:

> "... in normal cutting mode, when the disc cutter is presented to the cutting face the disc naturally rotates at about 30 to 40 RPM in the opposite direction to the shaft due to rubbing friction caused by the displacement difference between the diameter of the cutting disc and the oscillating path diameter, it will be appreciated that this low speed rotation in the cutting mode is advantageous because it provides for even wear of the cutting disc and prevents temperature build up at one point on the cutter".

The background goes on to state that,

> "...however, during free running mode, when the cutter is not in contact with the rock face, torque transmitted to the disc from the shaft through bearings 609 causes the disc cutter to rotate in the same direction as the shaft. Without some degree of control, the cutter would speed up to around the same speed as the shaft i.e. around 3000 RPM.
>
> Reapplying the cutter to the rock face causes an almost instantaneous acceleration of the disc from around 3000 RPM in one direction to around 30-40 RPM in the opposite direction. This can cause significant wear and damage to the cutting edge."

This is essentially the same problem mentioned in WO '486. <u>However</u>, WO '486 proposes a geared arrangement 616 (Figure 7) so that rotation of the cutting disc is controlled by <u>axial mechanical linkage</u> between the mounting plate and cutting disc.

In contrast to the solution proposed by WO '486, the present invention seeks to control the speed of the cutting disc by the axial bearings 605 and 700. In the disclosed embodiment and as recited in certain dependent claims, bearing 605 is a water lubricated bearing whereas bearing 700 is a special hydrostatic bearing designed to provide hydrostatic drag to prevent over-speeding of the disc.

Thus, while it is agreed that WO '486 disclsoes the problem that the present invention seeks to overcome, WO '486 does <u>not</u> disclose the solution disclosed and claimed by applicant and does <u>not</u> teach or suggest the structural features disclosed and claimed by applicant. Clearly WO '486 does not teach or suggest a first axial friction bearing to control speed, but rather discloses a mechanical gear for this purpose. It is therefore respectfully submitted that claim 1 is not anticipated by WO '486 and claim 1 and the claims dependent directly or indirectly therefrom are allowable over WO '486.

Reconsideration and withdrawal of the rejection over WO '486 is solicited.

Claims 4 and 8-13 were rejected under 35 USC 103(a) as unpatentable over WO '486 in view of Cooper or Arvidsson or EP document '377. The Examiner has also rejected all claims 1-20 under 35 USC 103 as unpatentable over WO '486 in view of Cooper or Arvidsson or EP '377. Applicant respectfully traverses these rejections.

The claims are submitted to be patentable over WO '486 for the reasons advanced above.

Indeed, as noted, WO '486 discloses a mechanical gear to control speed whereas the claimed invention uses an axial friction bearing to limit the rotational speed of the

disc. The Examiner has asserted that it would have been obvious to modify WO '486 to make the first bearing oil operated as taught by the cited three secondary references in order to allow the bearings to operate effectively at slow speeds as well as variable high speeds. Applicant respectfully but strongly disagrees.

Cooper generally discusses the technology of hydrodynamic film oil bearings. The advantages, as described at the bottom of page 2, are that the use of the hydrodynamic film of oil enables the shaft 10 to be given both some axial and some radial freedom thus enabling one to modify the frequency response to the system. Consequently, such a bearing will attenuate the forces transmitted by reason of any eccentricity in the shaft and due to eccentric rotation or swash between the bearing and fixed structure. In short, this document appears to be an early development of hydrodynamic bearings and lays down many of their advantages which are today well known in the art.

Arvidsson is a later development of hydrostatic axial bearing technology applied as a thrush bearing in a rotating disc crusher. In column 3, line 10 of the specification, Arvidsson has attempted to describe a hydrostatic thrust bearing which exhibits the capacity, proportional to the external applied axial loading, of absorbing either the whole or parts of the same irrespective of its magnitude or direction. The use of a hydrostatic bearing provides an increased capability of axial loading.

EP '377 is also directed to hydrostatic and hydrodynamic bearings with an emphasis on providing a hybridized bearing which operates effectively at low speeds as well as at variable high speeds of up to 4000 RPM.

The ability of hydrostatic bearings to withstand axial loading is indeed well known in the art. This fact is not refuted by applicant's specification. However, while the use of a hydrostatic bearing in the oscillating disc cutter for its ability to react axial loading is important, it is not the crux of the invention. Nor is the issue "allow the

bearings to operate effectively at slow speeds as well as variable high speeds" a suggested by the Examiner. Performance of the bearing at a range of shaft speeds is not the issue. The invention seeks to control, by what might be termed semi-active means, the rotational speed of the cutting head when free running by means of an axial friction bearing. Put another way, the invention is designed to limit the range of angular velocity of the shaft, not provide for operation in a wider range. The secondary references cited by the Examiner merely disclose hydrostatic bearings or applications thereof. They do not provide any indication or even remotely hint that such bearings may be used as a means for providing a measure of control of rotational speed, much less in an ODC. They certainly do not teach or suggest that WO '486 should be modified so as to eliminate the axial mechanical linkage WO '486 discloses and replaced it with a hydrostatic bearing. It is therefore respectfully submitted that the prior art documents cited by the Examiner would not provide the skilled artisan with the necessary information so as to be motivated to produce the claimed invention. It is therefore respectfully submitted that although the secondary references teach that hydrostatic bearings are known, they do not teach or suggest the modification of WO '486 to incorporate the same or to otherwise produce the claimed invention. It is therefore respectfully submitted that the Examiner's reliance on the secondary documents does not overcome the deficiencies of WO '486 in respect to the invention claimed. Reconsideration and withdrawal of the rejections are therefore requested.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and an early Notice to that effect is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ______________________
Michelle N. Lester
Reg. No. 32,331

MNL:slj

901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100